

Present Situation and Development of Masonry Structure Technology in China

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Abstract

Masonry structure refers to the wall and column made of block and mortar as the main stress members of the building, which is a general term of brick, block, masonry and stone masonry structure. Masonry structure in our country has a long history, from ancient times to the present our predecessors built a brilliant masonry building. As a large country in masonry research, the future development of masonry has a profound impact on the development direction of China's construction industry. At this stage, we should form our own different development system in the aspect of masonry structure, and should also divergent thinking to promote the possibility of different masonry development. After in-depth study of relevant literature, this paper makes a brief review of the current situation and future development trend of masonry structure technology in China.

Keywords

Masonry structure; current status; new type of block; the problem of the moment; prospects for development.

1. INTRODUCTION

Masonry structure refers to the wall and column constructed by block and mortar as the main stressed members of the building, which is a general term of brick masonry, block masonry, masonry and stone masonry [1]. Masonry structure in our country has a long history, from ancient times to the present our predecessors built a brilliant masonry building. Due to many advantages of masonry structure, masonry structure in China has a very broad prospect of use: the most important is that the masonry structure cost is low, and building materials according to local conditions is wide and convenient; it has good weather resistance and fire resistance. Good performance in thermal insulation effect; the construction is simple and can effectively save costly wood and steel. At present, no matter from the material, technology, structure and equipment research and application, or masonry structure theory research and calculation methods have been fully improved, with rapid development, masonry structure is entering a new stage of modern development [1].

China is a big country in masonry research, the development of masonry will also affect the development of China, at present in the development of masonry structure is forming China's own unique system, and according to China's own characteristics of masonry research and development, really walk in the forefront of the world. This paper makes a brief description of the development status and future trend of masonry structure in China after in-depth study.

2. DEVELOPMENT STATUS OF MASONRY TECHNOLOGY IN CHINA

2.1. Application of New Materials and Technologies

In the rapid development of masonry structure for decades, China's sand, industrial waste, carbonate made block development is extremely fast. In the past decade, the growth rate of masonry bricks has been over 20% [2]. At present, China mainly produces small and medium-sized blocks.

China began to make corresponding plans in the development of masonry structural materials in the 1980s, and the use of materials has become increasingly targeted. At present, China is vigorously promote the use of aerated concrete block, to replace clay brick more waste of resources, in China's national development and reform commission and ministry of jointly issued the "green action plan" in [3], known as "green building materials", one of the aerated concrete was listed among them, received extensive attention of the government and the social from all walks of life. In 2015, China's ministry of industry and information technology, and the housing and urban-rural development and released the action plan for promoting green building materials production and application, has been clear about the action target: 30% green building materials used in new buildings and green building application proportion reached 50%, 70% of pilot demonstration project application, existing buildings renovation application rate increased to 80% [4], this suggests that the aerated concrete block as green material in the future there will be huge as the construction industry. In February 2017, the ministry of housing and urban-rural development issued the 13th five-year plan on building energy conservation and green building development: by 2020, China will achieve a 20% increase in energy efficiency of newly built urban buildings compared with 2015, and the proportion of green building area in newly built urban buildings will exceed 50%, and the proportion of green building materials will exceed 40% [5]. The promotion of green building expands more space for the development of aerated concrete block. In this regard, the application and creation of materials in China are very promising.

2.2. Progress of Masonry Theory

At the beginning of the founding of the People's Republic of China, the relevant research theories of masonry structure were still in the initial stage, and no systematic theories had been formed. At that time, all existing theories guiding masonry construction were still mainly based on experience, and more were the experience summarized by thousands of construction personnel. In 1956, the ministry of construction of China approved the promotion and application of the former Soviet union's standards and technical specifications for the design of masonry and reinforced masonry structures [6]. In subsequent decades, through China's relevant departments under the leadership and organization, through the relevant issues of establishment, a lot of practice and experiment data, the end of the domestic situation of China gradually grope for suitable, practical and available, more advanced masonry structure theory, calculation methods and practical experience, gradually formed their own norms and guidelines of masonry structure, in many related aspects have characteristic in our country.

3. PROSPECT OF CHINESE MASONRY STRUCTURE

3.1. Green Building Materials

In 1988 the first international conference on materials research on relevant countries for the first time put forward the concept of "green building materials", green building materials is refers to the adoption of cleaner production technologies, with less natural resources and energy, extensive use of industrial solid waste or city production of non-toxic, no pollution, no radiation, beneficial to environmental protection and human health of building materials [7].

Subsequently, at the 1992 UN general assembly summit in Rio de Janeiro, Brazil, the declaration on agenda 21, with the theme of "environment and development", was adopted, confirming the development principle of "sustainable development". In recent years, the western developed countries in the implementation of "green building materials" has made great breakthrough and progress, unwilling to lag behind likewise, China in 1992, the United Nations summit on environment and development as an opportunity to rapidly organize scientific research strength, actively invest a large amount of manpower and material resources to develop the "green building materials products," at present, in order to obtain certain results.

3.2. Energy-Saving Measures for Building Walls

Sandwich composite wall masonry has good insulation performance, and excellent energy saving effect, wall structure can meet the service life of the building structure and many other advantages, so it has become the current and future wall energy saving reform and development of the main direction. Using clear water decoration brick as exterior wall decoration can save the time of making exterior wall insulation layer, pasting exterior wall brick or painting and the corresponding labor cost and material cost, improve the masonry efficiency and reduce the construction cost. In addition, the system is exposed to the harsh weather outside, which is the high-grade sintered brick with strong weather resistance, while the material with weak weather resistance is protected inside, avoiding the weakness of ordinary exterior wall finishes such as too fragile, easy cracking, falling off and short service life, etc., improving the durability of buildings and extending the service life of buildings [8]. Especially for cold and cold areas, the application of sandwich wall masonry building has been more and more popular in meeting the requirements of wall energy conservation.

3.3. Combination of Reinforced Masonry and Prestressed Masonry

Due to the advantages of reinforced masonry and prestressed masonry, such as high strength, good ductility, strong seismic resistance and fast construction speed, the steel content is relatively less uniform reinforced. So according to the stress characteristics of masonry structure in the corresponding parts configuration prestressed steel bar, increasing the constraint of masonry, delay cracking of masonry, strengthen the structure stiffness, thus improve the vertical bearing capacity of the masonry tensile strength and, in the solid clay bricks are limited by their weakness and eliminated, as our country many prestressed and reinforced masonry, high-rise building another idea and scheme of masonry, will have far-reaching sense to the development of China's construction industry [9].

3.4. High-Rise Masonry Structure

China's current code of masonry structure design has a strict limit on the building height of reinforced masonry shear wall structure, which is far from the height specified for reinforced concrete shear wall structure, which has become a bottleneck restricting the development of masonry structure. With the improvement of the theory and the innovation of technology, the development of masonry structure is bound to have a good prospect.

The office building of Kesheng Technology co., ltd. invested and constructed by Heilongjiang Construction Group adopts reinforced concrete block masonry shear wall structure and is built in Songbei district of Harbin [10]. 28 floors above the building, with a structural height of 98.8 meters; 1 underground floor with a height of 5.1m. The height difference between indoor and outdoor floors is 0.6m. The heights of the outdoor floor to the roof and the roof room of the building are 98.8m and 108.8m respectively, which is the first high-rise reinforced masonry building in China with a height of 100m [11]. The middle and high-rise building design with concrete block reinforced masonry structure can ensure the structural performance equivalent to concrete shear wall structure, but at the same time can reduce the carbon emission of building construction about 10.0%. Compared with cast-in-situ concrete shear wall structure,

reinforced masonry structure construction of high-rise housing has obvious low-carbon and energy-saving advantages, and is a "resource-saving and environment-friendly" green building structure form [12-13].

3.5. Theoretical Research on Masonry Structure

Until the 1950s, China only in the research, design, calculation and application of masonry structure made great achievements, mainly reflected in our country in different periods of the masonry structure specification: "The Masonry Structure Design Code" GBJ3-73, "The Masonry Structure Design Code" GBJ3-88, "The Masonry Structure Design Code" GB50003-2001 and "The Masonry Structure Design Code" GB50003-2011 [14] and other four versions. The code of masonry structure design in China has gone through three stages of development. The implementation of the limit state design method of "Masonry Structure Design Code" (GB50003-2011) based on probability theory marks that a relatively complete theory and application system of masonry structure design has been established in China. However, compared with foreign countries, there is still a certain gap, so it is necessary to deeply study the mechanical properties and failure mechanism of masonry structure. Through mathematical and mechanical models, the overall working performance of masonry structure is studied, and a more perfect theoretical system is established, which has far-reaching significance for promoting the development of masonry structure.

4. SUMMARY

China is a developing country, and its economic development is still unbalanced. For a long time to come, multi-story masonry houses will be widely used in small and medium-sized towns and rural areas, especially in residential buildings. In this paper, the development status, prospect and problems of masonry structure are briefly introduced. In the process of the development of masonry structure technology, carry out scientific research, fully tap the potential of technology, efforts to overcome the shortcoming of material, and thus improve the seismic performance of masonry structure, and its construction is simple, local materials and architectural appearance beautiful, have a certain security, in the future economic development plays a huge role.

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